These problems are due on Friday, Nov 20.

1. Air at 100 kPa and 300K is compressed continuously in a reversible, adiabatic, steady process to 800 kPa.
   a) Determine the final temperature (K) and work (kJ/kg) if \( c_p \) = constant.
   b) Determine the final temperature (K) and work (kJ/kg) if variations in \( c_p \) are considered.

2. Steam enters a well-insulated nozzle operating at steady state at 1000F, 500 psia and a velocity of 10 ft/s. At the exit, the pressure is 14.7 psia and the velocity is 4055 ft/s. Determine the rate of entropy production per lbm of steam flowing.

3. Liquid water at 20C is pumped from 10 kPa to 10000 kPa in a reversible process. Assume the water to be an incompressible substance.
   a) compute the work required per kg of water flowing if the process is adiabatic.
   b) compute the work required per kg of water flowing if the process is isothermal.

4. Air \( (c_p = 1.005 \text{ kJ/kg-K}) \) will be preheated using exhaust gas in a heat exchanger. Air enters at 95 kPa and 20C at 1.6 m\(^3\)/s. The combustion gases \( (c_p = 1.10 \text{ kJ/kg-K}) \) enter at 180C at a rate of 2.2 kg/s and leave at 95C. Determine:
   a) The rate of heat transfer to the air (kW).
   b) The rate of entropy generation (kW/K).